

The two prominent characters which separate this species from the last are the want of frontal excavation and the very narrow space between the eyes in the male.

I possess three examples from Miyanoshita and one from Kashiwagi.

XVIII.—On a new *Species* of *Semionotus*, from the Lower Oolite of Brora, Sutherlandshire. By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate VII.]

THROUGH the kindness of Prof. J. W. Judd, F.R.S., I have received from the Rev. J. M. Joass, LL.D., of Golspie, Sutherlandshire, some examples of an interesting fossil ganoid fish, from the Lower Oolites exposed in that district upon the coast. The specimens were discovered in a block of carbonaceous shale, believed by Dr. Joass to have been derived from the bed underlying the main seam of lignite in Strath Brora; and, as will appear from the description and figures, they are referable to a hitherto unknown species of *Semionotus*, adding one or two important items to our knowledge of the skeleton of this early genus*. Detached scales have already been recorded by Prof. Judd †, but no remains sufficiently perfect for specific determination seem to have been previously met with.

The most complete fossil (Pl. VII. fig. 1) shows the general form of the fish, with all the fins except the pelvic pair; but the shape and relations of the bones in the cephalic region have been rendered almost undistinguishable by crushing. A second specimen, with a portion of its counterpart, but destitute of the caudal fin, is even more dilapidated, though exhibiting some of the bones of the head and opercular folds. A fragment of a third individual shows a well-preserved pectoral fin and the upper lobe of the caudal pedicle; while a fourth is represented by its apparently entire caudal fin. A detached maxilla also displays the characters of that bone and its dentition.

* The most complete description of *Semionotus* hitherto published is by J. Strüver, "Die fossilen Fische aus dem Obern Keupersandstein von Coburg," Zeitschr. d. deutsch. geol. Gesellsch. vol. xvi. (1864) pp. 305-321, pl. xiii.

† J. W. Judd, "The Secondary Rocks of Scotland.—Part I.," Quart. Journ. Geol. Soc. vol. xxix. (1873) p. 194 (table).

Description.

As shown by Pl. VII. fig. 1, the fish is of a graceful fusiform shape, the greatest depth, slightly in advance of the dorsal fin, being contained about three and a half times in the total length. The head and opercular bones occupy not quite a third of the total length; and, as usual in the genus, the dorsal and anal fins are remote.

The *head-bones*, as just stated, are so much crushed that the complete outline of very few can be distinguished. The exposed surfaces seem to have been smooth, or only partially ornamented with scattered tubercles; but it is impossible to determine to which parts the ornament was confined. Of the inner bones, there are the remains of a pair, evidently vomerine or palatine, bearing series of stout conical teeth; and of the more external elements, the characters of the premaxilla and maxilla can be observed.

The *premaxilla* (fig. 2) constitutes but a small portion of the upper border of the mouth, and bears at least five strong conical teeth; it is produced above into a broad backwardly-directed process, the length of which is about twice as great as that of the dentigerous margin of the bone. The entire form of the element is remarkably similar to that of *Lepidotus*. The *maxilla* (fig. 3) has also a close resemblance to the corresponding bone in the last-named genus; it is very narrow in its anterior half, but becomes rapidly deeper behind, and the posterior portion attains a depth equalling about a third of the entire length of the dentigerous border; there is also articulated with the upper edge of this expansion a small distinct element, which may be interpreted either as jugal or as merely a dismemberment of the maxilla itself. The teeth are sharply conical and somewhat irregularly disposed, the larger ones being relatively far apart, and the smaller ones being closely set in the interspaces.

The posterior *branchiostegal rays* (fig. 4) are very broad distally, gradually tapering to the attached end; and between the rami of the mandible there is a large median *gular plate*. An impression of the inner aspect of the latter (fig. 5) is well shown in one of the specimens; its anterior half is almost horseshoe-shaped, and appears to be divided from the posterior broader portion by slight lateral notches.

Displaced and situated above the crushed head in the less perfect specimen, is a well-preserved scale-bone, which appears to be one of the series originally attached to the posterior margin of the pectoral arch. This (fig. 6) is vertically elongated, its length being equal to twice and a half its greatest breadth. It is of the form of a parallelogram, with

the antero-inferior angle slightly produced downwards, and the postero-superior somewhat rounded; but the upper two thirds of the anterior border were evidently considerably overlapped, leaving the exposed portion of the bone broader below than above. The outer enamelled surface is merely covered with scattered pittings and exhibits no ornamentation.

Of the *paired fins*, the pectorals (fig. 1) are long and powerful, but the pelvics are almost, if not quite, undistinguishable. The latter are always more or less rudimentary in *Semionotus*, but they seem to have been unusually small in the species now under consideration. Each pectoral fin consists of about ten robust rays, undivided for more than a third of their length, then becoming articulated and soon branching.

In the *median fins* the rays are similar to those of the pectoral just described—robust, proximally undivided, distally articulated and branching. The dorsal (fig. 1) is unfortunately mutilated, but there are traces of the double series of anterior fulcra, followed by about fourteen rays; and the fin is seen to commence in the middle of the back. The anal (fig. 1) commences at a point opposite the posterior end of the dorsal, and is preceded by two prominent and other smaller fulcra; it is, as usual, of small extent, but composed of rays of considerable length. The caudal fin is best displayed in the fragment shown in fig. 7, though its connexions are also seen in two of the other specimens. The extremity of the body is slightly produced upwards—a kind of semi-heterocercy—and the ridge-scales are continued behind as fulcra; the rays, however, are so disposed as to produce a completely symmetrical fin, and this is not forked, but somewhat rounded, the median rays extending beyond those above and below.

The *scales* are thick and covered externally with a smooth shining layer of ganoine. They are of rhomboidal form, varying slightly in different parts of the body, being deepest on the flanks (figs. 1, 8), and most oblique in the caudal region, while those of the ventral aspect (fig. 9) exhibit, to some extent, the elongation characteristic of genera like *Eugnathus*, &c. With one or two exceptions on the middle of the flank, none of the scales show the slightest trace of denticulations on the hinder edge. None, moreover, appear to be united by “peg-and-socket” joints; but there is the usual slight overlapping, and all are strengthened on the inner side by a vertical median rib.

Specific determination.

In his original description of the genus *Semionotus*, Prof.

Agassiz recognized six species—one from the Keuper and five from the Lias; in 1843 Sir Philip Egerton described three others from the Lower Jurassic of Italy, and in 1872 one from the English Kimmeridge Clay; a fourth Italian species was added by Costa, and two additional Keuper forms have been subsequently discovered—the one named by Dr. Oscar Fraas, from Württemberg, the other described by Mr. E. T. Newton, from Warwickshire.

Thirteen species have thus been referred to the genus under consideration, and of these the position of three seems doubtful, on account of the imperfection of known specimens, while a fourth may be unhesitatingly regarded as wrongly so placed. The three former are the Italian species described by Egerton, and the smallest of these (*S. minutus*) may eventually prove to be truly a *Notagogus*. The fourth species is the so-called *S. rhombifer*, Agass. *, from the Lower Lias of Lyme Regis, which Sir Philip Egerton has already recognized † as exhibiting a very close resemblance to *Heterolepidotus*. There can, indeed, be no longer any doubt that the fish in question belongs to the last-named genus, and the type specimen is quite possibly a young individual of *H. latus*, Egerton.

Tabulating the remaining twelve species, it will be convenient for reference to place them in stratigraphical order as follows; and to those of which the type specimens are now preserved in the British Museum an asterisk is prefixed.

SEMIONOTUS, Agassiz.

- Semionotus Bergeri*, Agass. Rech. Poiss. Foss. vol. ii. pt. 2, p. 224, pl. xxvi. figs. 2, 3. *Palaeoniscum arenaceum*, Berger, Verstein. Coburg. Gegend, 1832, p. 18, pl. i. fig. 1. *Semionotus Spixi*, Agass. tom. cit. p. 8. *Semionotus esox*, Berger, Neues Jahrb. 1843, p. 86. *Semionotus Bergeri*, von Schauroth, Zeitschr. deutsch. geol. Ges. vol. iii. (1851), p. 405, pl. xvii.; Bornemann, *ibid.* vol. vi. (1854), p. 612, pl. xxv.; Strüver, *ibid.* vol. xvi. (1864), p. 305, pl. xiii. figs. 1, 3, 4. —Upper Keuper, Coburg.
- Semionotus Kapffi*, Fraas, MS.—Keuper, Württemberg.
- Semionotus Brodiei*, Newton, Quart. Journ. Geol. Soc. vol. xliii. (1887) p. 537.—Keuper, Warwickshire.
- Semionotus latus*, Agass. tom. cit. p. 227, pl. xxvii. *Dapedius altivelis*, Agass. tom. cit. p. 8.—Lias, Seefeld, Tyrol.
- **Semionotus striatus*, Agass. tom. cit. p. 231, pl. xxvii. a. figs. 6, 7. —Lias, Seefeld, Tyrol.
- Semionotus Nilssoni*, Agass. tom. cit. p. 229, pl. xxvii. a. figs. 1–5; Nilsson, Trans. Acad. Sci. Stockholm, vol. xii. (1824), p. 103, pl. ii. figs. 1–3.—Lias, Schonen, near Bosarp, Sweden.
- Semionotus leptcephalus*, Agass. Neues Jahrb. 1832, p. 145; also tom. cit. p. 222, pl. xxvi. fig. 1.—Lias, Boll, Württemberg.

* L. Agassiz, Rech. Poiss. Foss. vol. ii. pt. 1, p. 228, pl. 26 a.

† Egerton, Figs. and Descr. Brit. Org. Remains (Mem. Geol. Surv.), dec. xiii. pl. ii.

Semionotus curtulus, Costa, Paleont. del Regno di Napoli, pt. 1 (1850), p. 64, pl. vi. figs. 4, 5, pl. vii. fig. 6, pl. viii. fig. 2; pt. 3, p. 81, pl. xi. fig. 1; also Ittiol. Foss. Ital. 1855, p. 25, pl. iii. fig. 1.—Lias, Giffoni, near Naples.

**Semionotus Pentlandi*, Egerton, Proc. Geol. Soc. vol. iv. 1843, p. 183.—Lias, Giffoni, near Naples.

**Semionotus pustulifer*, Egerton, *loc. cit.*—Lias, Giffoni, near Naples.

**Semionotus minutus*, Egerton, *loc. cit.* [[?] = *Notagodus*].—Lias, Giffoni, near Naples.

**Semionotus Manselii*, Egerton, Figs. and Descrip. Brit. Org. Remains (Mem. Geol. Surv.), dec. xiii. pl. viii. (1872).—Kimmeridge Clay, Dorsetshire.

Comparing the Brora fossil with each of the foregoing forms it soon becomes evident that the fish is specifically distinct. *S. Bergeri* obviously differs in the prominence of the serrations on the scales, and the larger size of the fin-fulcra, though agreeing well in general proportions. *S. Kapffi* and *S. Brodiei* are smaller species, and the former is considerably less fusiform. *S. latus* is likewise a much shorter and deeper species; and *S. striatus* is distinguished by the character of the superficial ornamentation of the head. *S. Nilssoni* has the scales of the flanks more vertically elongated, and is a comparatively deep-bodied fish. *S. leptcephalus* is very similar to the Brora fossil in general outline, but the tail is relatively smaller and the fin-rays apparently less robust. *S. curtulus*, *S. Pentlandi*, and *S. pustulifer* must have been all less elongated; while *S. minutus*, if really referable to the same genus, differs in the delicacy of the fin-rays and its remarkably elongate shape. Lastly, *S. Manselii* is readily separated by its larger dimensions, the well-developed pelvic fins, and the relatively greater depth of the trunk.

It thus becomes necessary to propose a new name for the species here described, and I would suggest that of *S. Joassi* as being most appropriate, in reference to the valuable researches of the Rev. Dr. Joass upon the geology of the north-eastern margin of the Highlands.

EXPLANATION OF PLATE VII.

Semionotus Joassi, A. S. Woodw., Lower Oolite, Brora, Sutherlandshire.

- Fig. 1.* Nearly complete fish; nat. size.
- Fig. 2.* Premaxilla; thrice nat. size.
- Fig. 3.* Maxilla; thrice nat. size.
- Fig. 4.* Posterior branchiostegal ray; twice nat. size.
- Fig. 5.* Gular plate; twice nat. size.
- Fig. 6.* Postclavicular plate; twice nat. size.
- Fig. 7.* Caudal fin; nat. size.
- Fig. 8.* Scales of flank, inner aspect; twice nat. size.
- Fig. 9.* Ventral scales, inner aspect; twice nat. size.